PERSPECTIVES ON THE QUALITY OF GROUNDWATER USED FOR DRINKING SUPPLY IN CALIFORNIA

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GAMA Priority Basin Project
Presentation to Water Quality Coordinating Committee
Sacramento, California
September 27, 2011

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- What is the Priority Basin Project?
- How does one obtain a comprehensive assessment?
- What have we learned?

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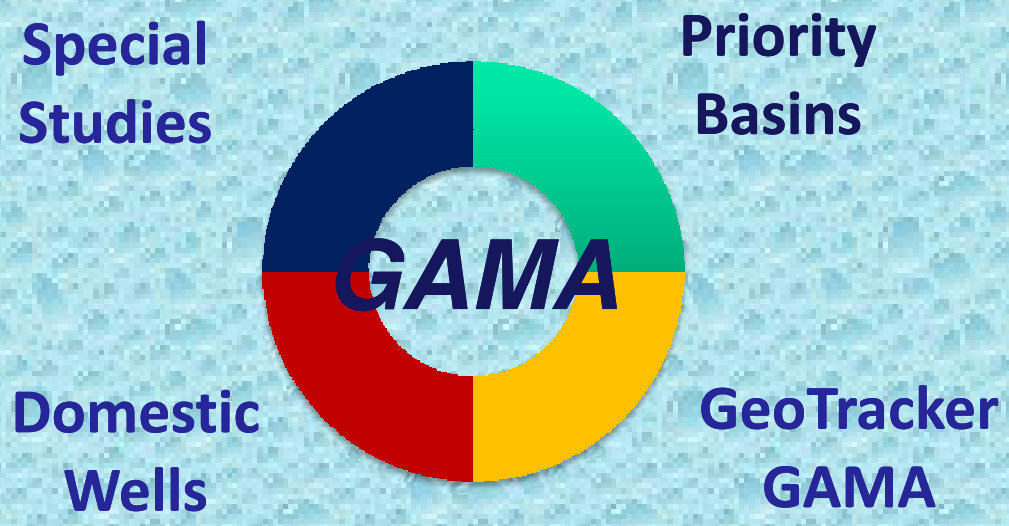
GAMA Program: Current Projects



Sampling conducted in *Voluntary Cooperation* with Participants

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AB 599: Groundwater Quality Monitoring Act Of 2001

Selected objectives

- Assess each ground-water basin in the state through direct and other statistically reliable sampling approaches
- Integrate existing monitoring programs and acquire new data as needed
- Prioritize ground-water basins that provide drinking water

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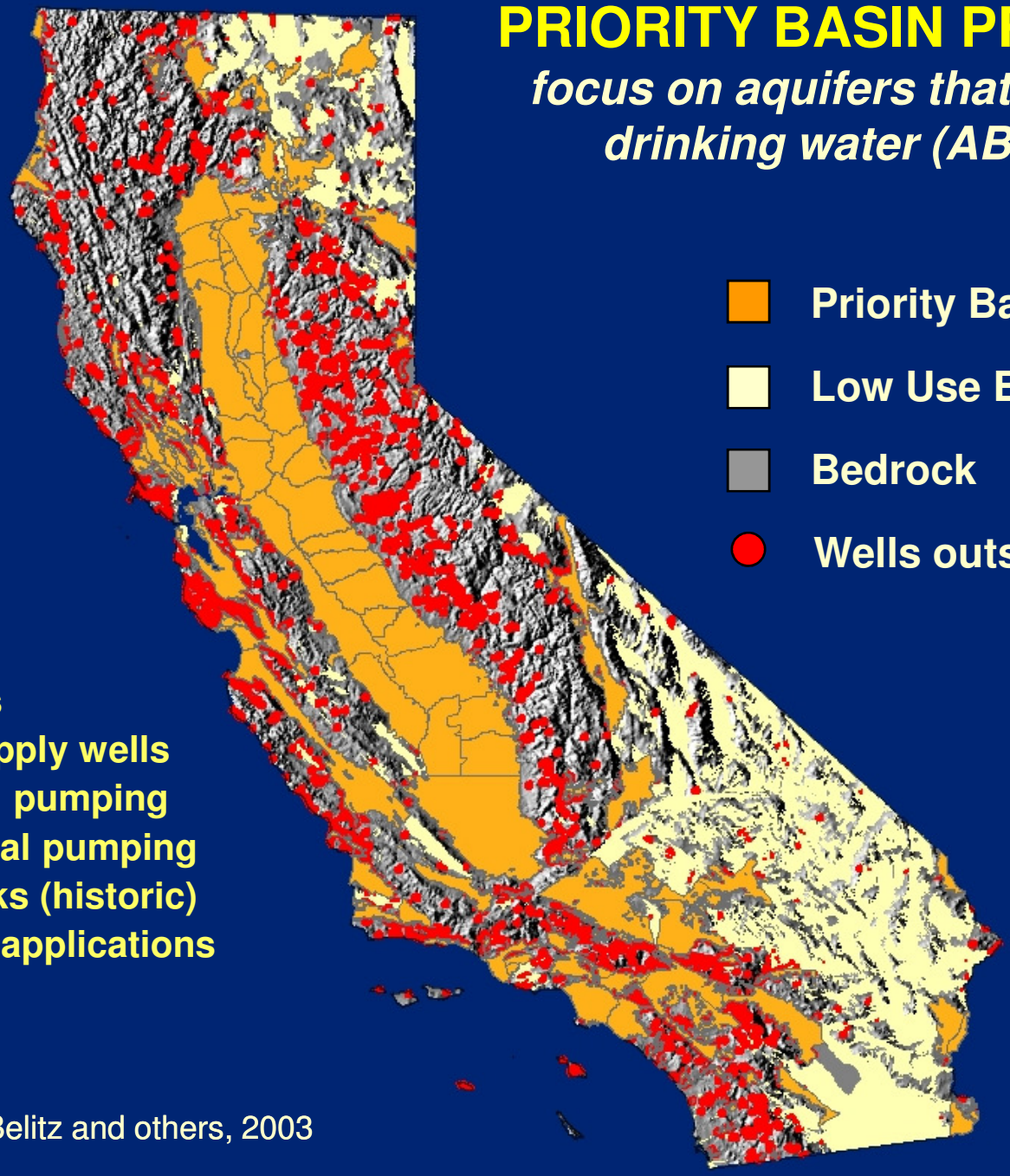
PRIORITY BASIN PROJECT

focus on aquifers that provide drinking water (AB 599)



- Priority Basins (116)
- Low Use Basins (356)
- Bedrock
- Wells outside basins

Priority basins
95% public supply wells
99% municipal pumping
90% agricultural pumping
90% leaky tanks (historic)
90% pesticide applications
60% area

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Belitz and others, 2003

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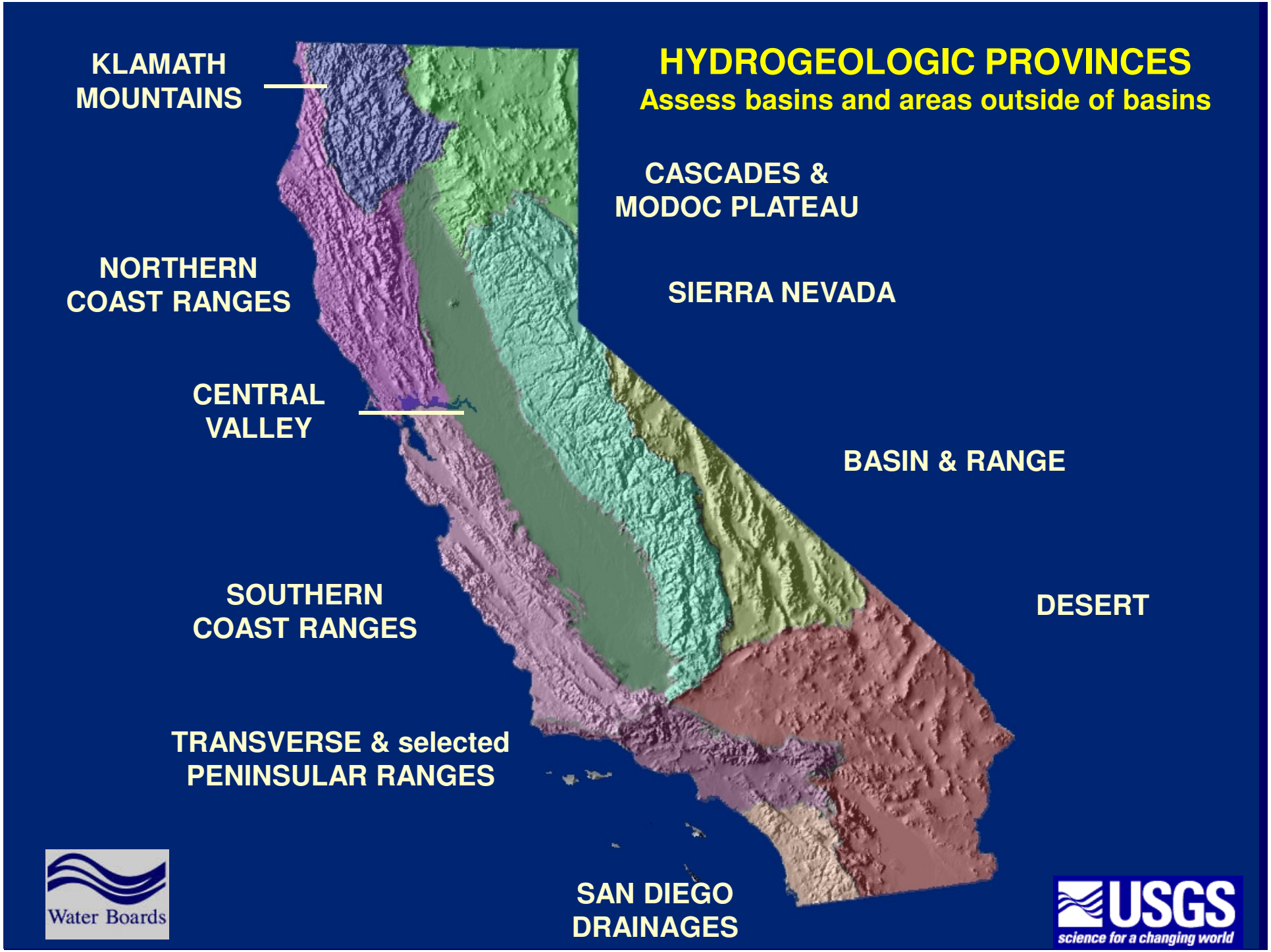
HYDROGEOLOGIC PROVINCES
Assess basins and areas outside of basins
KLAMATH MOUNTAINS
CASCADES & MODOC PLATEAU
NORTHERN COAST RANGES
SIERRA NEVADA
CENTRAL VALLEY
BASIN & RANGE
SOUTHERN COAST RANGES
DESERT
TRANSVERSE & selected PENINSULAR RANGES
SAN DIEGO DRAINAGES
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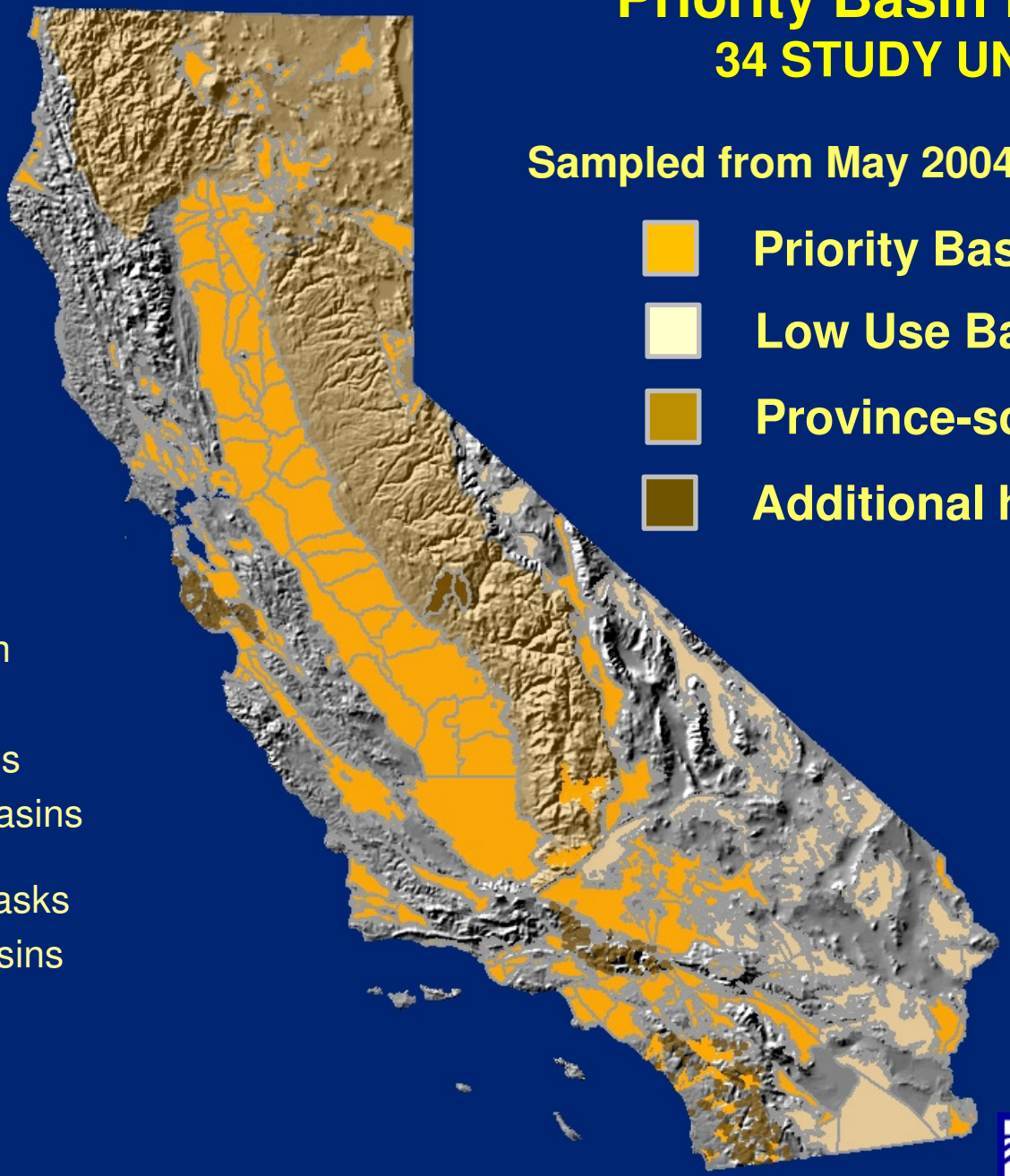
Priority Basin Project
34 STUDY UNITS



Sampled from May 2004 – Sept 2011

- **Priority Basins**
- **Low Use Basins, Desert**
- **Province-scale study**
- **Additional hard-rock**

Sampling completed in
- 116 Priority Basins
- ~ 50 Low-Use Basins
- 7 areas outside of basins

Remaining sampling tasks
- 1 area outside of basins
- Trends

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NETWORK DESIGN

- **Grid wells**
  spatially distributed, randomized network
- **Understanding wells**
  answer basin specific questions
- **Data from CA Dept of Public Health**
  ~ 16,000 public supply wells – regulated constituents

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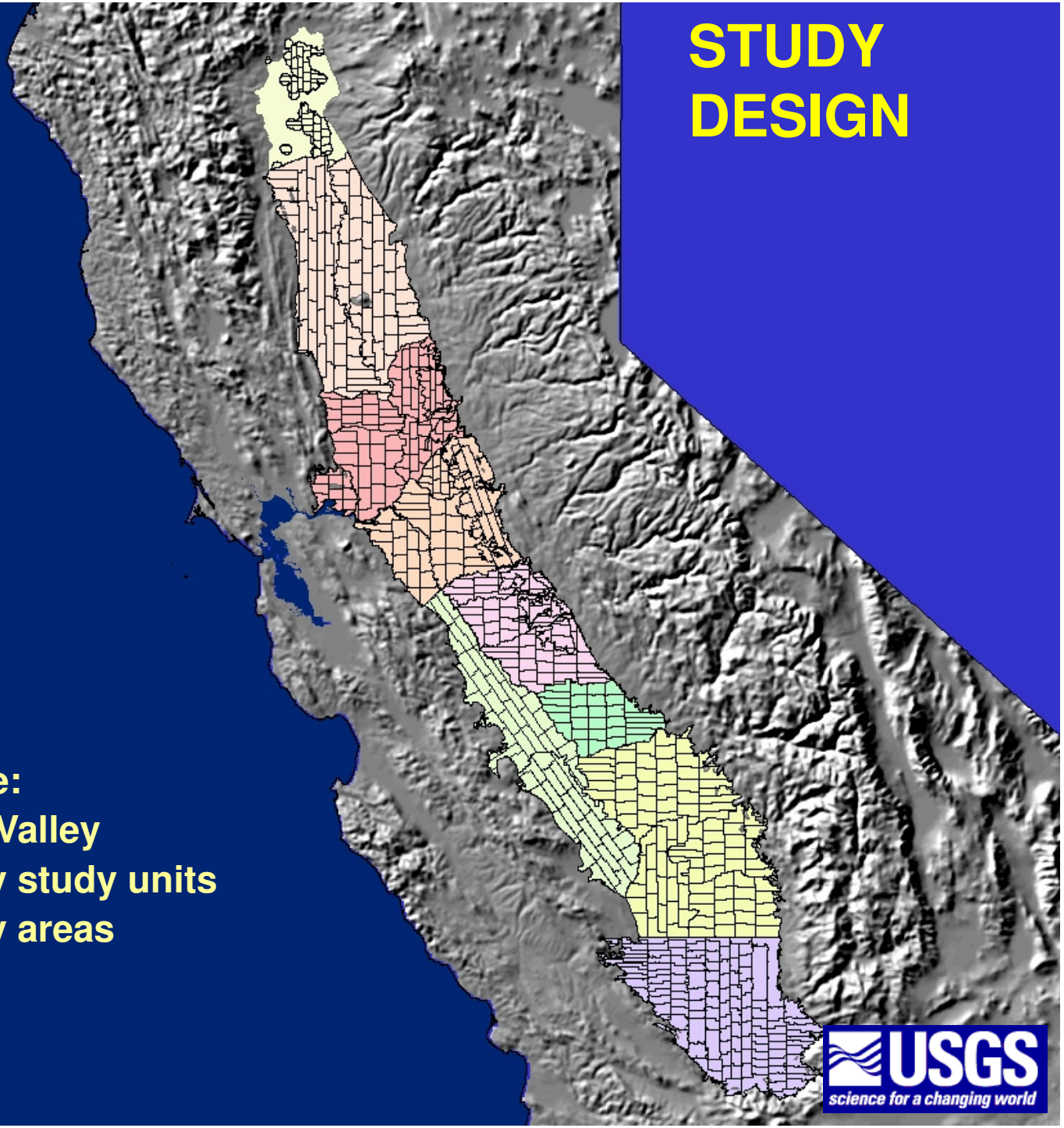
STUDY DESIGN



Example:
Central Valley
10 study study units
24 study areas

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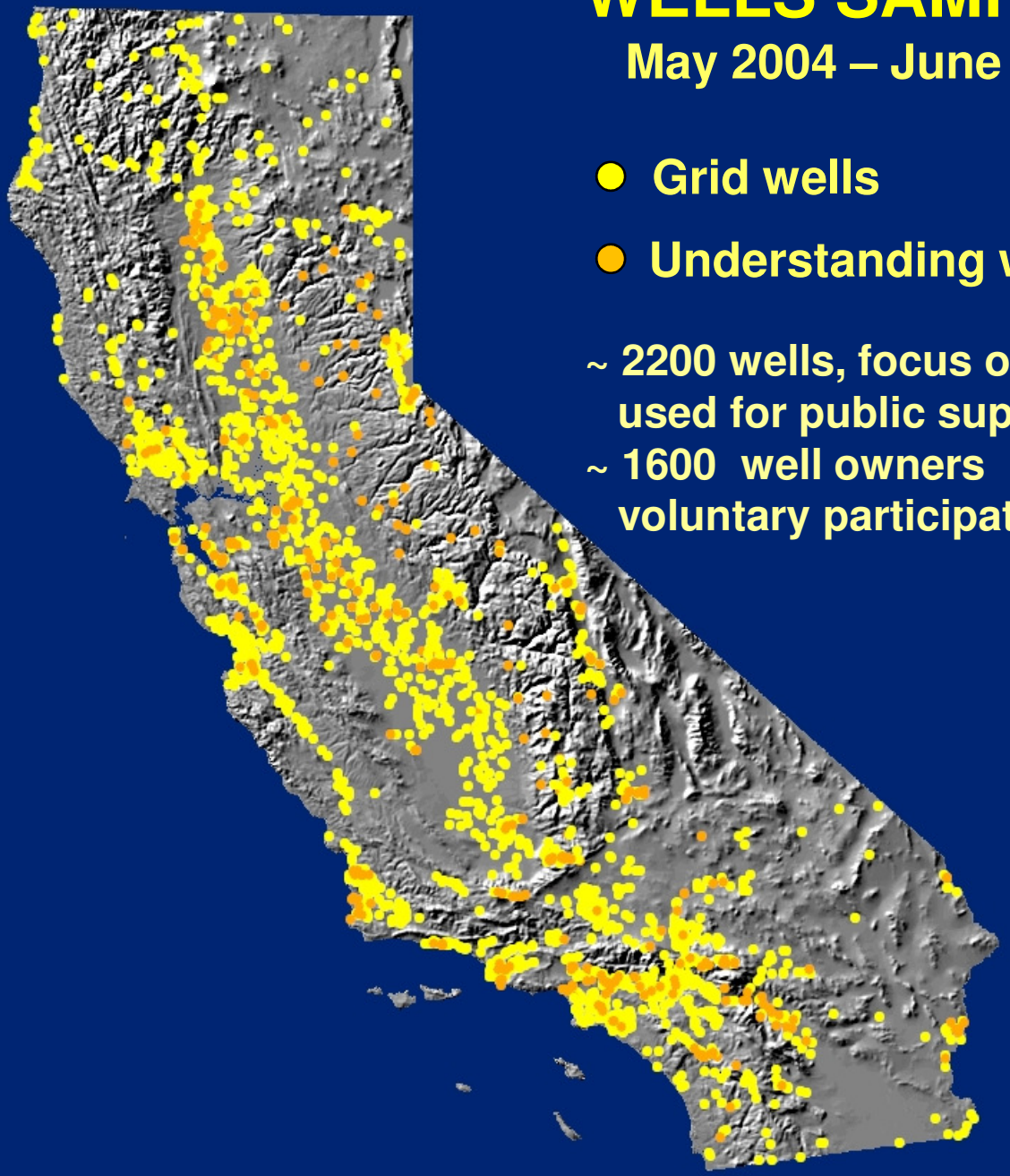
WELLS SAMPLED

May 2004 – June 2011



- Grid wells
- Understanding wells

~ 2200 wells, focus on depth zone used for public supply

~ 1600 well owners voluntary participation

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Data collected by USGS for GAMA

- **Water Quality Constituents – regulated & unregulated**
  Broad suite of inorganic & organic compounds
  Laboratory methods provide low level detections

- **Hydrologic Tracers & Geochemical indicators**
  Age tracers, pH, DO, etc.
  Provide a basis for understanding why concentrations are high

- **Ancillary Data**
  Hydrogeologic setting, well construction, contaminant sources, etc.

- **Communication**
  Public meetings, well-owner reports
  Geotracker-GAMA, USGS NWIS, USGS reports

WEB ***Print & WEB***

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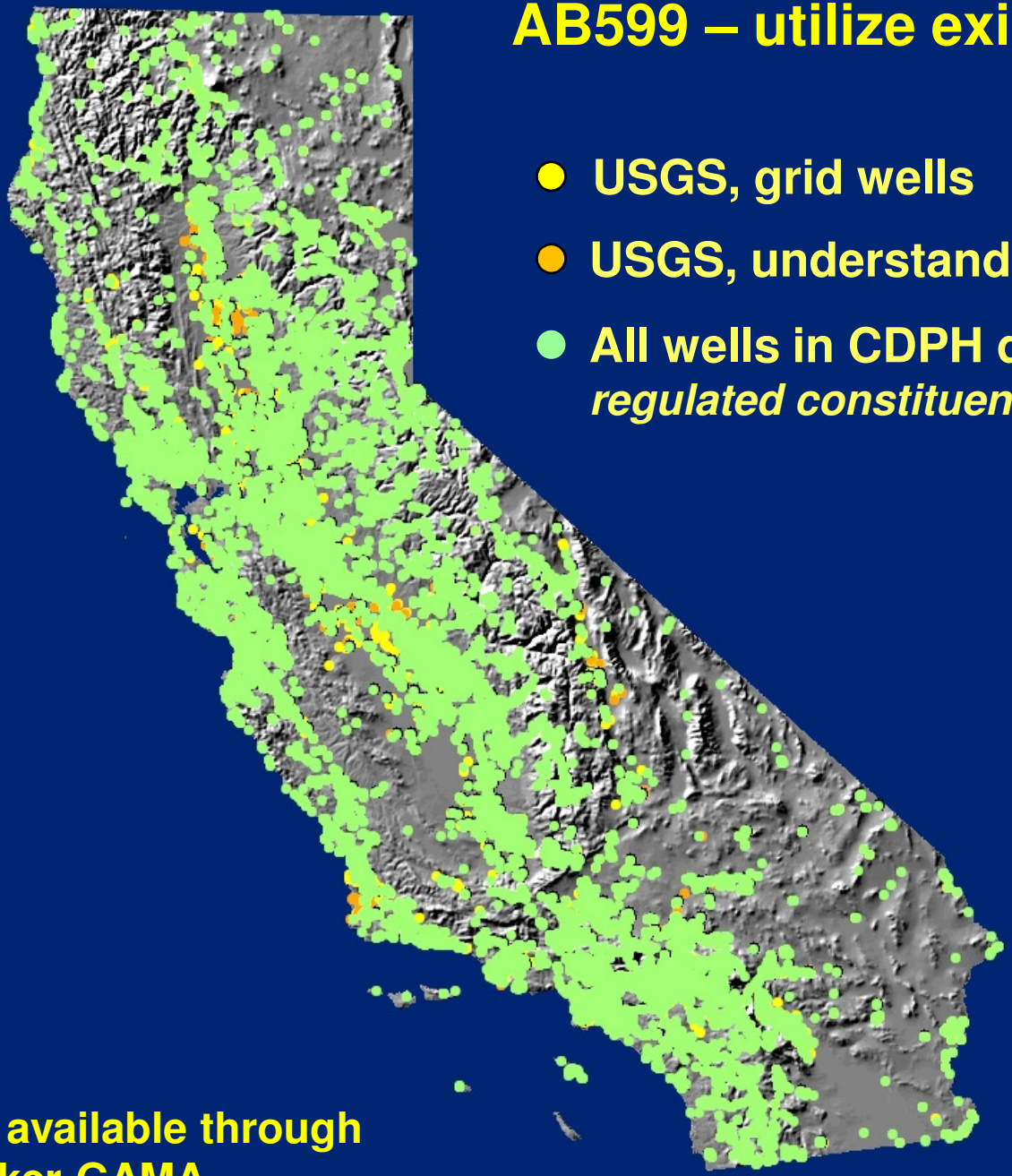
AB599 – utilize existing data



- USGS, grid wells
- USGS, understanding wells
- All wells in CDPH database
  regulated constituents

Data are available through GeoTracker-GAMA

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ASSESSMENT REQUIRES CONTEXT

- **Regulatory and non-regulatory health-based benchmarks**

  (1) Maximum Contaminant Levels, Action Levels, Treatment Technique Levels (3) Notification Levels, (4) Health Advisory Levels, (5) Risk Specific Dose

- **Aesthetic benchmarks**

  (2) Secondary Maximum Contaminant levels

- **Relative concentrations**

  environmental concentration divided by benchmark

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AQUIFER-SCALE PROPORTION

The primary metric for assessing groundwater quality at the basin scale

HIGH relative concentration > 1

MODERATE

0.1 < rel. conc. < 1 for organic
0.5 < rel. conc. < 1 for inorganic

LOW rel. conc. < 0.1 for organic
rel. conc. < 0.5 for inorganic

Organic constituents are generally introduced by people

Inorganic constituents occur naturally or can be introduced by people

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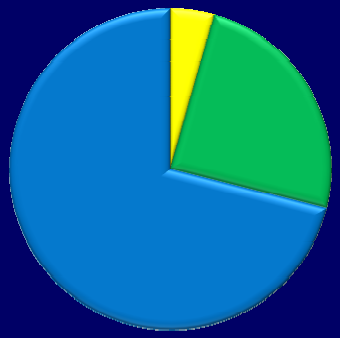
AQUIFER-SCALE PROPORTION



HIGH

MODERATE

LOW

- Primary focus is on depth zone used for public supply
- Concentrations in shallower and deeper groundwater can differ from concentrations in the zone tapped by public supply wells
- GAMA evaluates untreated water, not water delivered to consumers

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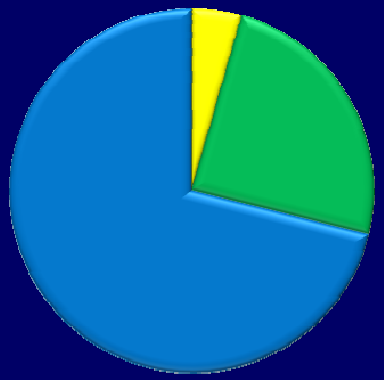
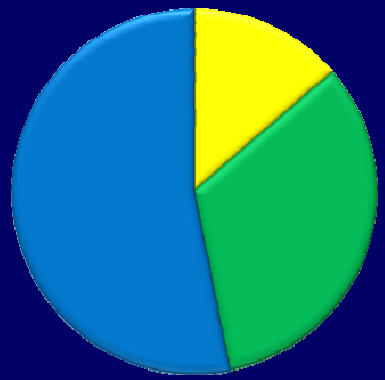
AQUIFER-SCALE PROPORTION

Constituent



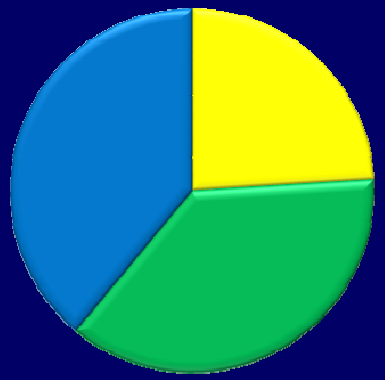
Vanadium

Class



Trace elements

Group of classes



Inorganics

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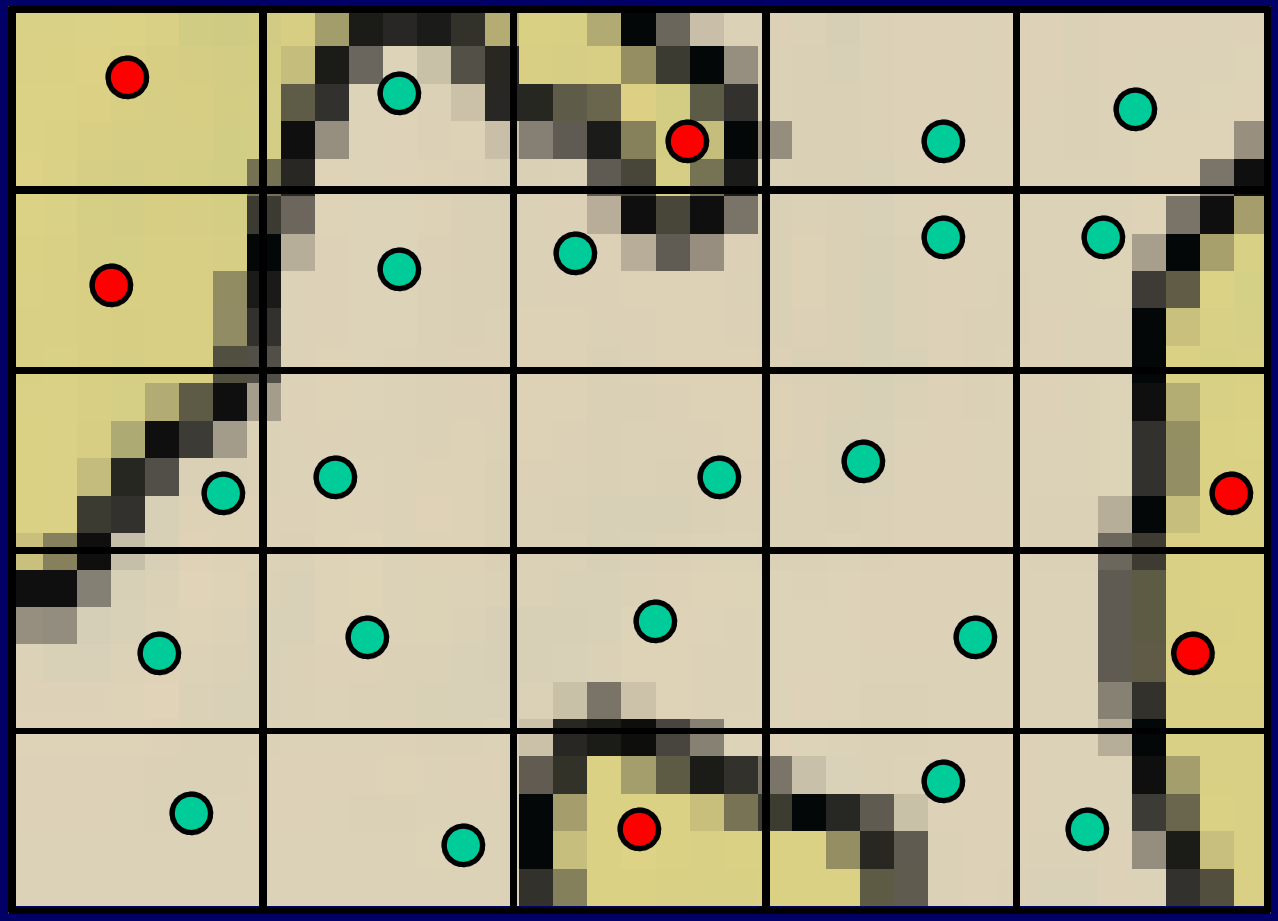
GRID-BASED PROPORTION



Grid-based
6/25 = 24%

PROPORTION = NUMBER HIGH / TOTAL NUMBER

AB599: use reliable statistical methods

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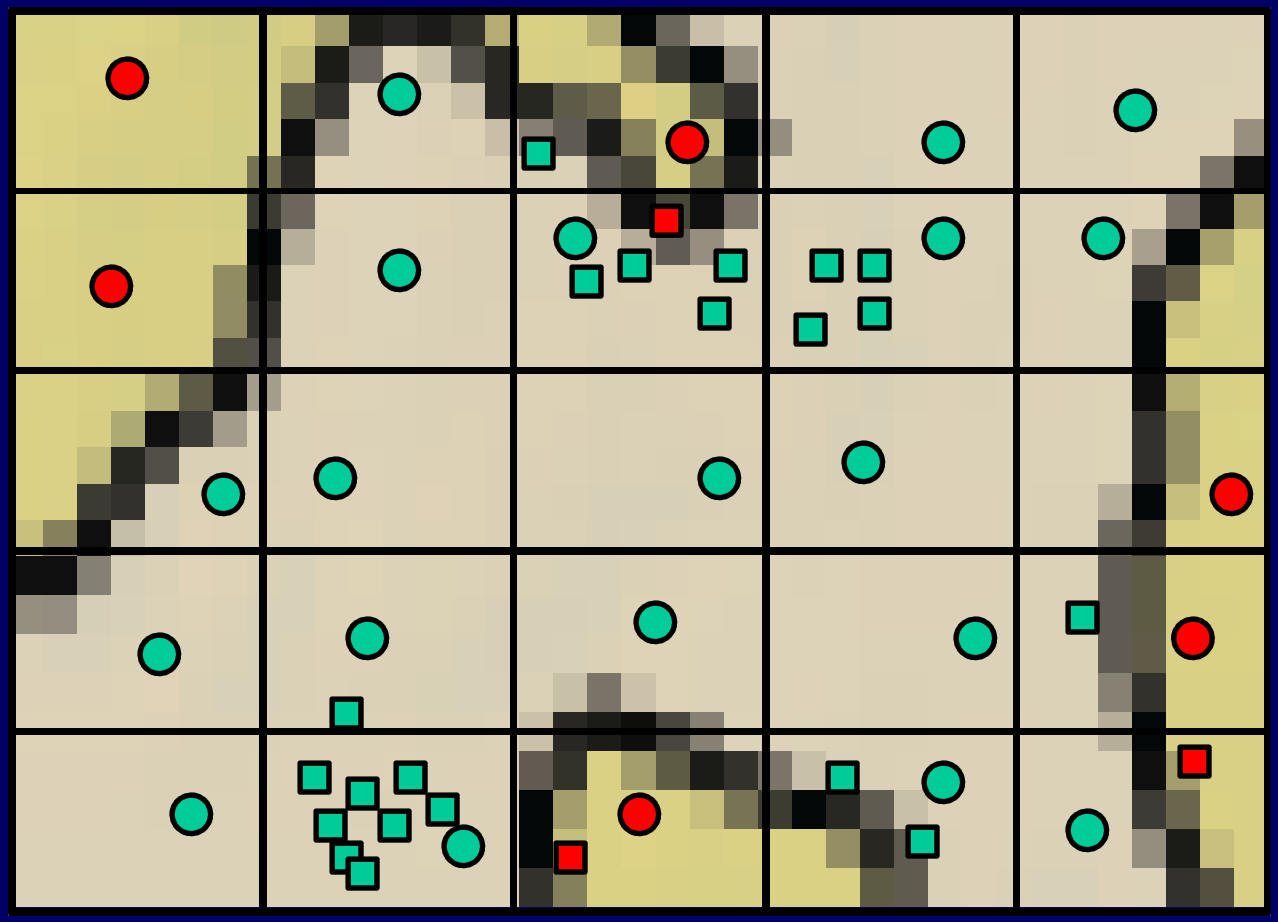
SPATIALLY-WEIGHTED PROPORTION



Grid-based
6/25 = 24%

"Raw"
9/49 = 18%

Sp. wted.
27%

- Compute proportion in each cell
- Proportion for entire area = average of cells
- Corrects for clustering of data

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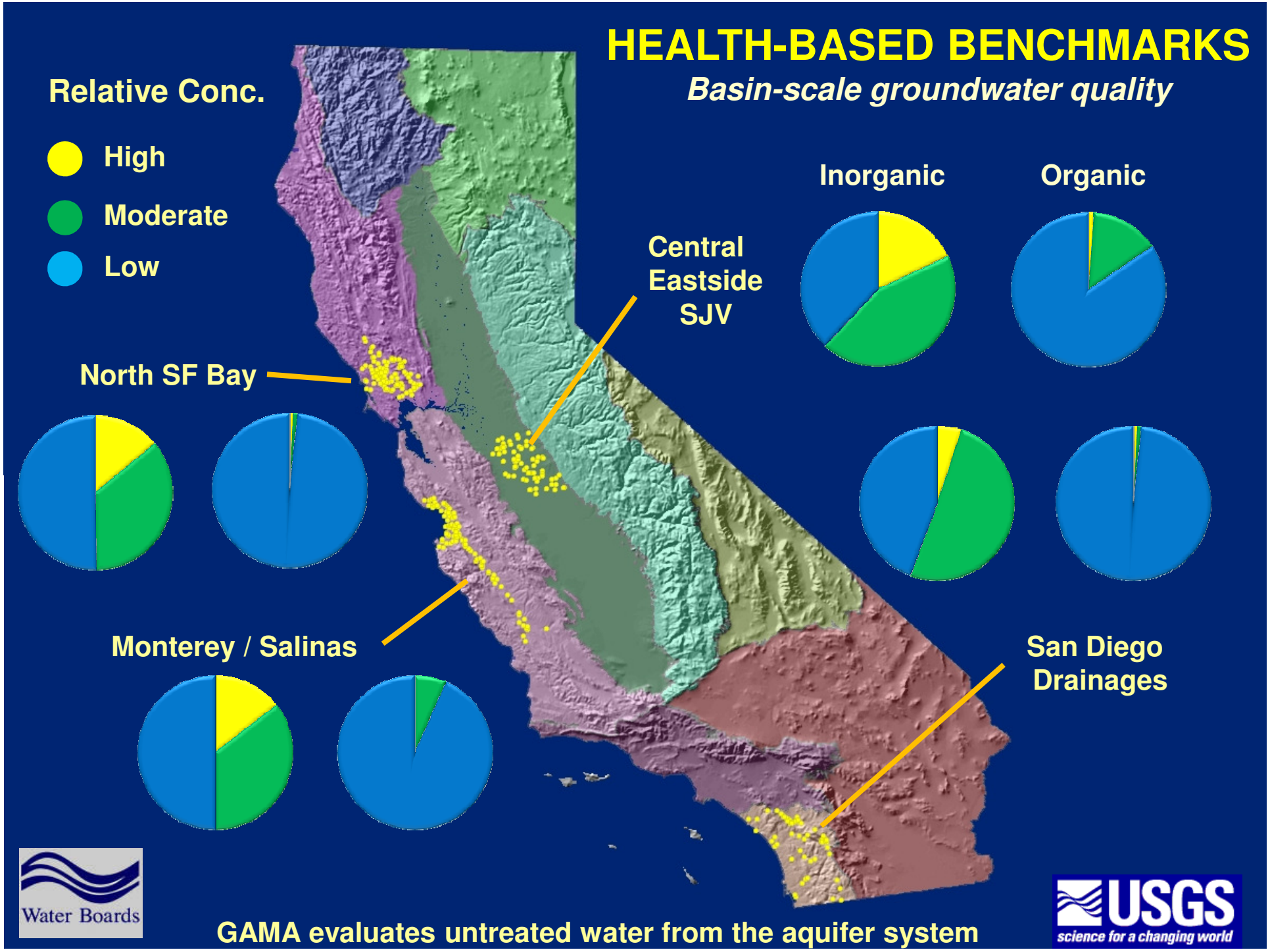
HEALTH-BASED BENCHMARKS

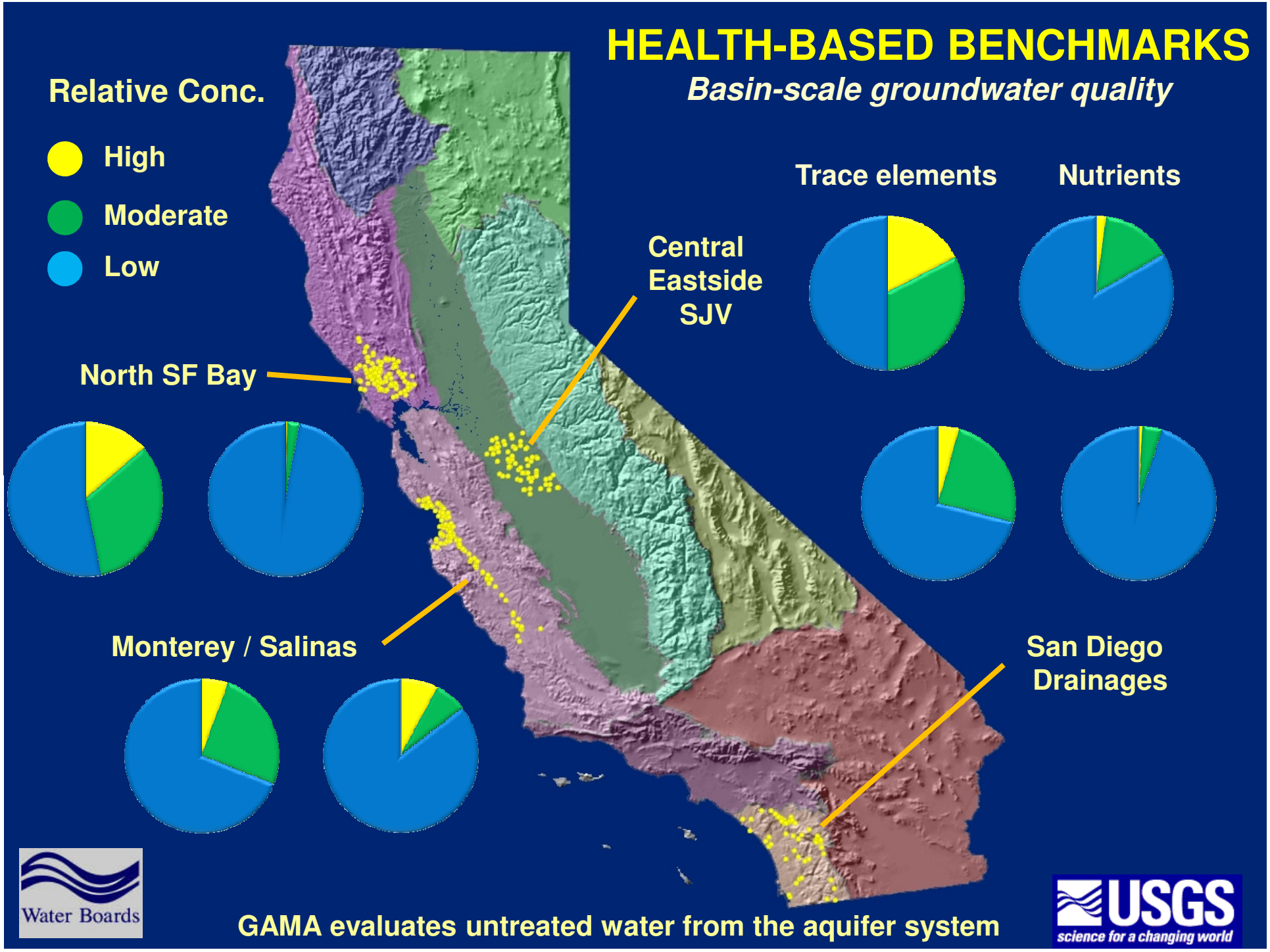
Basin-scale groundwater quality



GAMA evaluates untreated water from the aquifer system

HEALTH-BASED BENCHMARKS

Basin-scale groundwater quality



What have we learned?

- **Health-based benchmarks, relative concentrations, and "aquifer-scale proportions" provide a context for comparing different constituents and different study units**
- **From the perspective of public supply aquifers (statewide), inorganic constituents are more prevalent at high concentrations than human-introduced organic constituents**
- **From the perspective of public supply aquifers (statewide), naturally occurring trace elements and radioactivity are more prevalent at high concentrations than human-introduced nitrate**
- **Results in some basins may vary from statewide patterns. For example, solvents in the San Gabriel & San Fernando Valleys (15% to 20%)**

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Implications for management of groundwater quality

- **Naturally occurring trace elements and radioactivity are more prevalent at high concentrations than human-introduced nitrate and organic compounds**
- **Naturally occurring trace elements – blending, remediation, abandonment**
- **Human-introduced compounds – additional options related to human activities**

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QUESTIONS?

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http://ca.water.usgs.gov/gama

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